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MEMORANDUM

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TO: Elizabeth Leland, EC
Project Manager, Carbon Monoxide Detection

Through: Mary Ann Danello, Ph.D. *M. A. Danello*
Associate Executive Director for Epidemiology and Health Sciences

Susan Ahmed, Ph.D. *S. Ahmed*
Director, Hazard Analysis Division

FROM: Kimberly Ault, EHHA *K. A.*

SUBJECT: Estimates of Non-fire Carbon Monoxide Poisoning Deaths and Injuries

Executive Summary

For more than a decade, the U.S. Consumer Product Safety Commission (CPSC) has been concerned about the number of accidental non-fire deaths attributed to carbon monoxide (CO) poisoning associated with the use of consumer products within the jurisdiction of CPSC. Between 1990 and 1994, the number of non-fire CO poisoning deaths associated with use of consumer products averaged about 230 per year. The total number of accidental non-fire CO poisoning deaths, including both deaths associated with consumer products and deaths associated with motor vehicle exhaust averaged annually about 580 between 1990 and 1994. The CO poisoning deaths attributed to motor vehicle exhaust accounted for about 60 percent of all accidental non-fire CO poisoning deaths. The remaining 40 percent of the deaths were associated with consumer products. Most of the non-fire consumer product-related CO poisoning deaths were associated with the use of heating systems. Other consumer products associated with these poisoning deaths included charcoal grills, gas water heaters!, camping equipment, and gas ranges and ovens.

On average, between 1992 and 1996, approximately 9,800 people were treated in hospital emergency rooms for non-fire CO poisoning injuries associated with consumer products, excluding incidents involving auto exhaust. The estimated poisonings treated in hospital emergency rooms have increased between 1992 and 1996. Some of the increase in reports of non-fatal CO poisonings could be attributed to increased awareness of CO poisoning by both consumers and the medical community. The presence of a CO detector in the marketplace and recent public educational efforts may have helped consumers recognize symptoms of CO poisoning and seek treatment at local hospitals.

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This report provides estimates of non-fire CO poisoning deaths and reported injuries associated with the use of non-vehicular consumer products for the latest years data are available and gives an overview of the problem of CO poisoning. Data from previous years have been reexamined to provide greater detail and to assure use of consistent methodology; thus estimates of non-fire consumer product-related CO poisoning deaths and injuries have changed from previous memoranda. Appendix 1 provides a detailed discussion of the changes.

Introduction

Carbon monoxide is a colorless, odorless, and poisonous gas that results from the incomplete combustion of fuels such as natural or liquid propane (LP) gas, oil, wood, coal, and other fuels. The health effects related to CO depend upon its concentration in air, the duration of exposure, and its **concentration** in blood, as well as each individual's general health. Carbon monoxide combines with hemoglobin (Hb) with an affinity about 250 times that of oxygen, forming carboxyhemoglobin (COHb) and interfering with oxygen transport, delivery, and utilization. Generally, there are no perceptible health effects or symptoms in healthy individuals at COHb levels of 10 percent. Symptoms at blood levels above 10 percent COHb include headache, fatigue, nausea, and cognitive impairment. Loss of consciousness, coma, and death can occur at COHb levels greater than 20 percent. At around 3 percent COHb, a decrease in time to onset of angina in exercising individuals with ischemic heart disease, electrocardiographic changes, and neurobehavioral effects in healthy individuals has been recorded (Long & Saltzman, 1995; Burton, 1996).

Some symptoms of CO poisoning may mimic common illnesses such as influenza or colds; thus there likely is a high incidence of initial misdiagnosis by physicians and victims (Long & Saltzman, 1995). Patients are frequently unaware of exposures, and health care providers are not always aware of the symptoms of CO poisoning. COHb formation is reversible, as are some clinical symptoms of CO poisoning. However, some delayed neurological sequelae that develop following severe poisonings with prolonged unconsciousness may not be reversible. Prompt medical attention is important to reduce the risk of permanent damage.

Any fuel-burning appliance can potentially be a source of fatal or near-fatal CO levels. Fuels, such as natural and LP gas, kerosene, oil, gasoline, coal, and wood can produce large amounts of CO when there is insufficient oxygen available for combustion. Consumer products that burn kerosene, oil, gasoline, coal or wood (such as wood stoves, oil boilers, and kerosene heaters) produce an irritating smoke that can alert the victim to a potentially hazardous situation. Other products, such as charcoal briquettes and pressed **woodchip** logs, produce relatively smokeless fues, even at times of inefficient combustion. Victims receive no obvious sensory warning that high CO levels are present. A different hazard scenario is present when gas appliances are not vented properly or are malfunctioning. Natural and LP gas burn more efficiently and cleanly compared with other forms of fuel. In circumstances of inadequate ventilation or defective exhaust pathways, natural and LP gas appliances may emit potentially lethal amounts of CO without any irritating fumes. Again, many victims may be unaware of a potential problem.

Non-fire Carbon Monoxide Poisoning Deaths

During 1994, the most recent year for which death certificate data are available, there were an estimated 223 non-fire CO poisoning deaths associated with the use of consumer products, excluding motor vehicles. Table 1 relates the distribution of non-fire CO poisoning deaths attributed to consumer products and the various fuel types involved. Of these 223 deaths, heating systems were involved in 177 of the fatal incidents. In many incidents, limited information was available about the type of fuel used. The estimates presented in the table below are based on reported information about the various types of fuels. Among the specified heating system fuel types, LP gas heating was associated with 35 deaths, natural gas heating was associated with 24 deaths, and unspecified gas heating systems were associated with 59 deaths. Other heating system fuel types reported included kerosene and oil (9) and coal and wood (6). Unspecified fuel type heating systems were reported in 44 of the fatal incidents. These 177 deaths associated with heating systems total almost 80 percent of all consumer product-related CO poisoning deaths reported in 1994. Other consumer products reported to have been involved in CO poisoning deaths were charcoal grills (15), camp cooking stoves and lanterns (12), gas ranges and ovens (9), and gas water heaters (7). Other appliances, such as propane refrigerators and fuel-powered tools, were reportedly associated with 3 deaths. Other deaths associated with fuel-powered, "motor/engine" type appliances, such as generators, pumps, lawn mowers, and snowblowers have been reported to CPSC, however estimates of these poisoning deaths are not available. (See Appendix 2.)

Table 1
Estimated Non-Fire Carbon Monoxide Poisoning Deaths
by Type of Consumer Product Reported, 1990 - 1994

Consumer Product	Average Percent	1990	1991	1992	1993	1994
Total Deaths	100%	243	250	211	214	223
Heating Systems	73%	176	186	139	152	177
Unspecified Gas Heating	19%	36	53	24	44	59
LP Gas Heating	15%	31	35	43	27	35
Natural Gas Heating	9%	10	34	22	14	24
Coal/Wood Heating	5%	29	8	9	7	6
Kerosene/Oil Heating	5%	13	17	6	10	9
Heating Systems, Not Specified	20%	57	39	35	50	44
Charcoal Grills	10%	21	25	27	27	15
Gas Water Heaters	5%	17	13	6	11	7
Camp Stoves, Lanterns	5%	13	10	17	10	12
Gas Ranges/ Ovens	5%	10	14	13	6	9
Other Appliances	2%	6	3	9	7	3

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1990 - 1994.

Notes: Detail may not add to total due to rounding.

The 1990 - 1993 estimates presented in this table have been revised. See Appendix 1 for explanation.

Additionally, Table 1 shows the estimated number of deaths for 1990 to 1994. On average, the annual number of non-fire CO poisoning deaths for this period is approximately 230 (with a standard deviation of 17.6). The average annual estimated deaths have remained fairly constant from 1990 to 1994, with only small variations from year to year. A regression analysis did not show a significant decrease in the estimated total number of non-fire CO poisoning deaths during this period. However, a regression analysis showed a significant decrease in the estimated CO poisoning deaths between 1980 and 1994. Appendix 3 shows the estimated CO poisoning deaths between 1980 to 1994. (See note in Appendix 3 for p-value.) Table 1 also shows the average percentage of deaths by the various reported products. On average, about 70 percent of the deaths involved heating systems and 10 percent involved charcoal grills. The remaining deaths were associated with other consumer products including gas water heaters, camp stoves and lanterns, gas ranges/ovens, and other fuel-powered tools and appliances. Each of these products was associated with 5% or less of the five year average number of deaths.

Table 2 shows that, from 1990 to 1994, on average, children under 15 years of age accounted for about 8 percent of the deaths, and persons over 65 accounted for about 20 percent. Deaths among the other age groups ranged between 20 and 30 percent of the total number of CO poisoning deaths. On average about 70 percent of these victims were males and 30 percent were females. Most of the deaths (75%) occurred from October through March, the primary months when heating appliances are used.

Table 2
Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Age of Victim, 1990 - 1994

Age	Average Percent	1990	1991	1992	1993	1994
Total	100%	243	250	211	214	223
Under 5	3%	9	9	6	7	10
5 - 14	5%	14	15	10	12	7
15-24	21%	51	50	45	40	50
25 -44	28%	71	72	56	64	55
45 - 64	22%	45	52	50	52	50
65 and over	21%	53	52	44	39	51

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1990 -1994.

Table 3 shows that almost 80 percent of the fatal incidents involved only one person, but about 20 percent of the incidents involved two or more persons.

Table 3
Number of Reported Deaths per Non-Fire Carbon Monoxide Poisoning Incident, 1990 - 1994

Number of People in Incident	Average Percent	1990	1991	1992	1993	1994
Total Incidents	100%	127	128	123	120	123
1	78%	101	95	90	96	102
2	17%	19	26	27	18	17
3	3%	1	4	3	6	2
4	1%	2	1	3	0	1
5 or more	1%	4	2	0	0	1

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, 1990 - 1994.

Note: Data in Table 3 do not add to totals presented in Table 1. Data presented in Table 3 are not estimated deaths, but instead reported deaths in the CPSC DCRT file. NCHS data does not contain enough detail to identify CO poisoning death incidents.

Table 4 shows that two-thirds of deaths occurred in homes, including mobile homes and garages. The remaining incidents occurred in locations such as sport or recreational areas, streets or highways, and other remote areas, where the victims were spending the night in automobiles or trucks and/or camping. In some of the "camping" incidents, the victims were burning charcoal inside automobiles and tents to keep warm. Many incidents occurred in sheds or other such out-buildings, in "make-shift" temporary shelters, in trucks with "caps", and campers or trailers. Some of the deaths involved victims who were staying at a work site overnight, using portable gas heaters to keep warm.

Table 4
Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Location of Death 1990 - 1994

Location of Death	Average Percent	1990	1991	1992	1993	1994
Total	100%	243	250	211	214	223
Home	67%	166	175	120	147	161
Camper / Tent	13%	34	36	45	11	22
Auto	7%	14	15	14	17	15
Other	4%	6	13	9	10	12
Unknown	9%	23	11	24	29	13

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1990 - 1994.

Note: Detail may not add to total due to rounding.

Non-Fire Carbon Monoxide Non-Fatal Poisonings

Estimates of non-fatal poisonings from CO exposure are difficult to determine. Many victims do not seek medical attention or, when they do seek medical attention, may be misdiagnosed, since symptoms can be similar to those associated with colds and the flu. Carbon monoxide victims entering emergency rooms typically complain of fatigue, headache, nausea, dizziness, shortness of breath, chest pain, diarrhea, and other symptoms. In the ideal cases, the physician quickly recognizes the possibility of CO poisoning and the victim's COHb is measured as soon as possible after suspected CO exposure. However, in many cases the victim is misdiagnosed and recognition of CO poisoning is either delayed or does not occur.

In 1996, the latest year for which emergency room data are available, approximately 15,400 people were treated in hospital emergency rooms for suspected non-fire CO poisoning. Table 5 shows a distribution of these incidents by the kind of product reported to be associated in the incident. In 1996, heating systems, primarily furnaces and heaters, contributed to approximately 9,300 poisonings. Gas or LP gas heating appliances (3,300) and kerosene or oil heating systems (600) were the two types of heating systems that contributed to many of these poisonings. Coal or wood heating systems, including fireplaces and chimneys (400), and unspecified fuel-type heating systems (5,000) contributed to the remaining heating system-related poisonings. Other products reported as being involved in a CO poisoning incident included gas ranges and ovens (900), portable generators and pumps (700), grills (600), fuel-powered tools (500), gas clothes dryers (400), and gas water heaters (100). Often, gas ranges and ovens were inappropriately used for heating purposes. The portable generators and pumps were typically used to remove flood water from homes. Fuel-powered tools included floor waxers or buffers, power saws, welding equipment, snow blowers, lawn mowers, and lanterns.

The remaining 2,800 poisonings shown in Table 5 in the "No Product Specified" category were reported as incidents involving CO detectors without mention of a fuel-burning appliance and/or incidents where fuel storage tanks and pipes were reported as the product involved. Of these poisonings, 1,600 were reported as involving CO detectors without any source of CO mentioned. In about half of these CO detector incidents, the victims reported CO poisoning symptoms and the remaining half did not report any symptoms. In the incidents where no symptoms were reported, victims were often referred to the emergency room by the fire department or visited the hospital after repeated alarms from their CO detector. A CO detector is required to sound before any noticeable symptoms occur in healthy individuals. Therefore, some of the incidents can be attributed to asymptomatic people visiting the hospital emergency room after their CO detector sounded. Additionally, false positive or nuisance alarms triggered by low level CO exposures may have contributed to these incidents.

Table 5 also shows the estimated number of non-fatal CO poisonings for 1992 to 1996. The annual average number of non-fire CO poisonings for this period is 9,800 (with a standard deviation of 3,547). Table 5 also shows the average percentage of products reportedly contributing to the poisonings. Heating systems, primarily furnaces and heaters, contributed to over 70 percent of all poisonings. Where fuel type was specified, gas and/or LP gas heating appliances contributed to 27 percent, kerosene and/or oil heating systems contributed to 10 percent and coal and/or wood heating systems contributed to 4 percent. On average, gas ranges

and ovens contributed to 6 percent of the poisonings, grills contributed to 4 percent, and portable generators and pumps also contributed to 4 percent. The remaining products, fuel-powered tools, gas water heaters, and gas clothes dryers each contributed 3 percent or less of the poisonings. The poisoning incidents where no fuel-burning product was reported contributed to 10 percent of the average total.

Table 5
Estimated Non-Fire Carbon Monoxide Poisonings by Type of Consumer Products Reported, 1992 - 1996

Type of Product	Average Percent	1992	1993	1994	1995	1996
Total Non-Fatal Poisonings	100%	5,700	8,400	10,000	9,400	15,400
Heating Systems	71%	4,400	5,800	7,900	7,100	9,300
Gas / LP Heating	27%	2,100	1,900	3,100	2,600	3,300
Kerosene / Oil Heating	10%	900	600	1,400	1,200	600
Coal / Wood Heating	4%	100	0	600	800	400
Other Heating	1%	100	300	200	0	0
Heating Systems, Not Specified	29%	1,200	3,000	2,600	2,500	5,000
Gas Ranges / Ovens	6%	100	500	600	900	900
Grills	4%	400	700	0	100	600
Charcoal Grills	3%	300	700	0	0	300
Other Grills	1%	100	0	0	100	300
Portable Generators and Pumps	4%	300	400	500	100	700
Fuel-Powered Tools	3%	100	100	400	200	500
Gas Water Heaters	2%	100	400	300	300	100
Gas Clothes Dryers	1%	0	0	100	0	400
No Product Specified	10%	500	600	400	800	2,800
Sample Size		119	192	230	235	334
Coefficient of Variation		0.19	0.17	0.18	0.16	0.18

Source: U.S. Consumer Product Safety Commission / EHHA.

National Electronic Injury Surveillance System, 1992 - 1996.

Notes: Detail may not add to total due to rounding.

The t-test p-values for testing differences between years are as follows: 1992- 1993 (0.0568), 1993- 1994 (0.4438), 1994-1995 (0.7232), and 1995-1996 (0.0241). A significant value is a value less than 0.025 for a 95% confidence test.

The 1992 - 1995 estimates presented in this table have been revised. See Appendix 1 for explanation.

The estimated poisonings have increased **from** 5,700 in 1992 to 15,400 in 1996. Some of the increase in the non-fatal CO poisonings could be attributed to increased awareness of CO poisoning by both consumers and the medical community. The presence of a CO detector in the marketplace and recent public information efforts by CPSC and other organizations may have helped consumers recognize symptoms of CO poisoning and seek treatment at local hospitals. CO detectors may have contributed to the increased injury estimates due to false positive alarms resulting from oversensitive CO detectors. Table 5 shows the coefficient of variation of each yearly estimate.

To determine whether the number of poisonings is increasing or decreasing from one year to the next, a t-test which compares means and takes account of covariances between years was done. This test detects non random differences in the estimates. The test showed a significant increase between 1995 and 1996, but not for any other successive year pairs. (See note below Table 5 for p-values.) Thus, the fluctuation between 1995 and 1996 in the estimated number of reported non-fatal CO poisonings is not what is to be expected from random variation from year to year. There is evidence of a true increase in the estimated number of reported non-fatal CO poisonings from 1995 to 1996. However, it is unclear what proportion of the increase is due to a true increase in the actual number of medically confirmed non-fatal CO poisonings versus an increase in the reporting of unconfirmed CO exposures.

Table 6 shows that, from 1992 to 1996, on average children under 5 years of age accounted for about 15 percent of the non-fatal CO poisonings and persons over 65 accounted for less than 10 percent. Non-fatal CO poisonings among the other age groups ranged between 10 and 30 percent of the total number of CO poisonings.

Table 6
Estimated Non-fire Carbon Monoxide Poisonings by Age of Victim, 1992 - 1996

Age	Average P e r c e n t	1992	1993	1994	1995	1996
Total	100%	5,700	8,400	10,000	9,400	15,400
Under 5	15%	500	1,400	1,500	1,500	2,200
5 - 14	21%	900	1,500	1,800	2,000	4,000
15-24	13%	900	900	1,400	1,400	2,000
25 - 44	30%	1,800	2,200	3,000	3,300	4,400
45 - 64	13%	700	1,500	1,600	800	2,000
65 and over	7%	700	900	700	400	800

Source: U.S. Consumer Product Safety Commission / EHHA.

National Electronic Injury Surveillance System, 1992 - 1996.

Note: Detail may not add to total due to rounding.

Table 7 shows that most victims of non-fatal CO poisonings were examined or treated in the hospital emergency room and then released. Less than 10 percent of the poisonings required admission for hospitalization.

Table 7
Estimated Non-Fire Carbon Monoxide Poisonings by Disposition of Victim, 1992 - 1996

Disposition	Average Percent	1992	1993	1994	1995	1996
Total	100%	5,700	8,400	10,000	9,400	15,400
Treated & Released	90%	4,200	7,200	9,500	9,200	15,100
Hospitalized	9%	1,300	1,200	500	200	300
DOA	0%	100	0	0		0
Unknown	0%	100	0	*	•	100

Source: U.S. Consumer Product Safety Commission / EHHA.

National Electronic Injury Surveillance System, 1992 - 1996.

Note: The asterisk denotes that the estimate is less than 50. Detail may not add to total due to rounding.

Table 8 shows the distribution of the number of persons injured in each CO poisoning incident. Fifty-five percent of the incidents involved only one person, 21 percent of the incidents involved two persons, 13 percent involved three persons, 6 percent involved four persons, and the remaining 5 percent involved more than five persons.

Table 8
Number of Persons Injured Per Non-Fatal Carbon Monoxide Poisoning Incident, 1992 - 1996

Number of People in Incident	Average Percent	1992	1993	1994	1995	1996
Total Incidents	100%	68	108	119	122	168
1	55%	44	64	60	67	86
2	21%	10	25	29	21	38
3	13%	10	9	16	17	24
4	6%	1	6	7	12	9
5 or more	5%	3	4	7	5	11

Source: U.S. Consumer Product Safety Commission / EHHA.

National Electronic Injury Surveillance System, 1992 - 1996.

Discussion

About two-thirds of all consumer product-related non-fire CO poisoning deaths and injuries were associated with some type of heating system. Each of the CO poisoning hazard scenarios reflects either product malfunction resulting in high CO emissions and/or some failure to adequately remove CO from the living or recreational environment. Most of the deaths and injuries likely resulted from one of the following hazard scenarios: unvented products operated in closed spaces without adequate ventilation, faulty installations, long-term use accompanied by neglected maintenance, or inappropriate use of products for heating purposes. To prevent CO poisoning incidents, consumers need to make sure their appliances are properly installed, maintained, and used. Additionally, consumers should install a CO detector that meets requirements of the Underwriters Laboratories (UL) standard 2034 or the International Approval Services (IAS) 6-96 standard.

Appendix 1 Methodology

Non-fire Carbon Monoxide Deaths

All death certificates filed in the U.S. are compiled by the National Center for Health Statistics (NCHS) into multiple cause of mortality data files. The mortality data files contain demographic and geographic information as well as the International Classification of Diseases codes for the underlying cause of death and up to 20 contributing conditions. The data are compiled in accordance with the World Health Organization instructions, which request that member nations classify causes of death by the current Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death. The International Classification of Diseases, Ninth Revision was implemented in 1979 and was in effect between 1990 and 1994, the years for which data are presented in this report.

The following methodology was used to determine non-fire CO poisoning deaths associated with the use of consumer products. The first step in the estimation process is searching the NCHS data for the following external cause of death codes (Ecodes):

- 867.0 (Accidental poisoning by gas distributed by pipeline),
- 868.0 (Accidental poisoning by liquidified petroleum distributed in mobile containers),
- 868.1 (Accidental poisoning by other and unspecified utility gas),
- 868.3 (CO from incomplete combustion of other domestic fuels).

These deaths were combined for the total known non-fire CO poisoning death count (n_1), excluding motor vehicle exhaust. The deaths of unknown origin are found in the Ecodes 868.8 (CO from other sources) and 868.9 (Unspecified CO). A relative proportion (n_2) of these unknown deaths was added to the known death count. The proportion was based on a ratio of the unknown deaths (n_2) to the known count (n_1) plus the death count for motor vehicle exhaust (n_3). (The death count for motor vehicle exhaust is found in Ecode 868.2). The ratio was then applied to the unknown CO poisoning deaths (n_2). The adjusted total count of CO poisoning deaths is the sum of the total known CO poisoning deaths count plus the proportion of CO poisoning deaths of unknown origin. $[N = n_1 + ((n_1 / (n_1 + n_3)) * n_2)]$ This total is used to weight the death counts from the CPSC Death Certificate File. The table below shows the above computations for the 1990 - 1994 estimates.

Accidental Non-Fire Carbon Monoxide Poisoning Deaths by Ecode					
Adjusted E code Totals	Year				
	1990	1991	1992	1993	1994
867.0	42	26	30	19	35
868.0	69	63	67	73	85
868.1	20	24	17	16	16
868.2	377	369	316	335	359
868.3	111	138	98	105	87
Total Accidental CO Deaths	620	619	527	549	582
Consumer Product Total	243	250	211	214	223

Source: National Center for Health Statistics Mortality File, 1990 - 1994.

Note: Detail may not add to total due to rounding.

The next step in the process is to search the CPSC's Death Certificate File for the same **Ecodes** as used above (867.0, 868.0, 868.1, 868.3, 868.8 and 868.9). Each death certificate was reviewed and assigned a code based on the product and type of fuel involved, whenever possible. The incidents were grouped into the following fuel categories: unspecified gas, LP gas, natural gas, coal, wood, kerosene, oil, and unspecified. The heating systems category combined wall heaters and furnaces, floor furnaces, boilers, space heaters, heating stoves, and other miscellaneous heating systems. In order to project a national estimate of CO poisoning deaths from the CPSC death certificate file, product-specific percentages were applied to the NCHS estimate previously derived in step one. The result is an estimate of **non-fire** CO poisoning deaths associated with the use of consumer products. The table below shows the weighting factors used for the 1990 - 1994 estimates.

Year	Consumer Product Total	CPSC Death Certificate Count	Weighting Factor
1994	223	151	1.48
1993	214	150	1.43
1992	211	165	1.28
1991	250	179	1.40
1990	243	170	1.43

Source: U.S. Consumer Product Safety Commission / EHHA.

National Center for Health Statistics Mortality File, CPSC Death Certificate File, 1990 - 1994.

Product-specific estimates of non-fire consumer product-related CO poisoning deaths have been revised using the above methodology. The methodology used previously in the 1990 - 1993 estimates combined product categories which resulted in inflated product-related CO poisoning death estimates. For example, camp stoves were combined with gas ranges and ovens, which inflated the number of deaths associated with gas ranges and ovens. Additionally, the process of allocation of unknown products among the known products categories inflated estimates of certain product-related CO poisoning deaths. When products were combined in the gas fuel category, detailed information about the type of fuel (natural gas or LP gas) used in the incident was lost in the combination. The new methodology presents the data with as much detail as possible.

In addition to the new methodology, CPSC reviewed the CO poisoning death certificate data and found supplemental information collected since the publication of the previous memos. The new methodology and updated data explain the noticeable changes in previous estimates.

Non-fire Carbon Monoxide Poisonings Treated in Hospital Emergency Rooms

The estimated number of CO non-fatal poisonings treated in hospital emergency rooms is based on the National Electronic Injury Surveillance System (NEISS). The NEISS is a probability sample of hospitals selected from the population of all hospitals with emergency rooms (ERs) in the U.S. and its territories. The hospitals in the sampling frame are stratified by size (number of emergency room visits) into four groups. The hospitals are organized geographically within strata; substrata of equal number of hospitals are then formed, and a simple random sample of primary and alternate hospitals is selected from each stratum. Injuries

associated with consumer products and recreational activities are collected on a daily basis via a computer **from** each participating hospital. Data in this report were based on a sample of 91 hospitals that provides approximately 3~00,000 product-related injury reports each year (McDonald, 1994). Because of the properties of a probability sample, the number of reported injuries is weighted to represent all similar injuries in the U.S. and its territories. In addition to this capability for making estimates for the entire population based on sample data, probability samples also permit computation of confidence intervals around the estimates. The confidence intervals are derived from the statistical variability associated with the sample or the sampling error (Kessler, 1995).

Product-specific estimates of non-fatal, non-fire, consumer product-related CO poisonings have been revised. The estimates provided in previous memoranda (Long, 1995; Long, 1996) excluded incidents where CO detectors were mentioned as the only consumer product involved and incidents where **fuel** storage tanks and pipes were reported as the products involved. In the memorandum that presented NEISS data from 1994 (Long, 1995), the estimated number of non-fire CO poisoning injury incidents was presented instead of the estimated number of non-fatal poisonings (injuries). An injury incident was defined as an incident where at least one person was treated in a hospital emergency room. The 1994 estimate presented in this memorandum is the estimated number of non-fatal poisonings (which is considerably higher than the injury incident estimate). Additionally, the NEISS data and supplemental information collected since the publication of the previous memos were reviewed and, as appropriate, added to the estimated number of non-fatal CO poisonings. These additional incidents explain the noticeable changes in previous estimates.

Appendix 2

In the NCHS data, the Ecode 868.2 is used for reporting non-fire CO deaths associated with motor vehicle (not in transit) **exhaust** and CO deaths associated with the use of farm tractors, gas engines, motor pumps, and any other type of combustion engine not in watercraft. CPSC does not routinely collect death certificates for Ecode 868.2, since most motor vehicles are not within the jurisdiction of CPSC; thus appropriate weighting factors (as discussed in Appendix 1) are not available to make estimates associated with these products. Based on the methodology described in Appendix 1, the five year average proportion of actual non-fire CO poisoning deaths reported to CPSC, relative to the NCHS national count, is about 72% of all consumer product-related non-fire CO poisoning deaths (or a weighting factor of 1.4). Appendix 1 shows the CPSC Death Certificate File counts and the associated weighting factors for available years. If this factor is applied to the counts below, the five year average estimate of non-fire CO poisoning deaths associated with generators and other motor-type products is 16. The table below shows the number of reported non-fire CO poisoning deaths associated with generators and other “motor/engine” appliances, such as pumps, lawn mowers, and snowblowers.

Non-Fire CO Poisoning Deaths Associated with Generators and Other Appliances

Appliance	1990	1991	1992	1993	199
Total	18	8	7	13	11
Generators	18	7	7	10	7
Other Products	0	1	0	3	4

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, 1990-1994.

Appendix 3

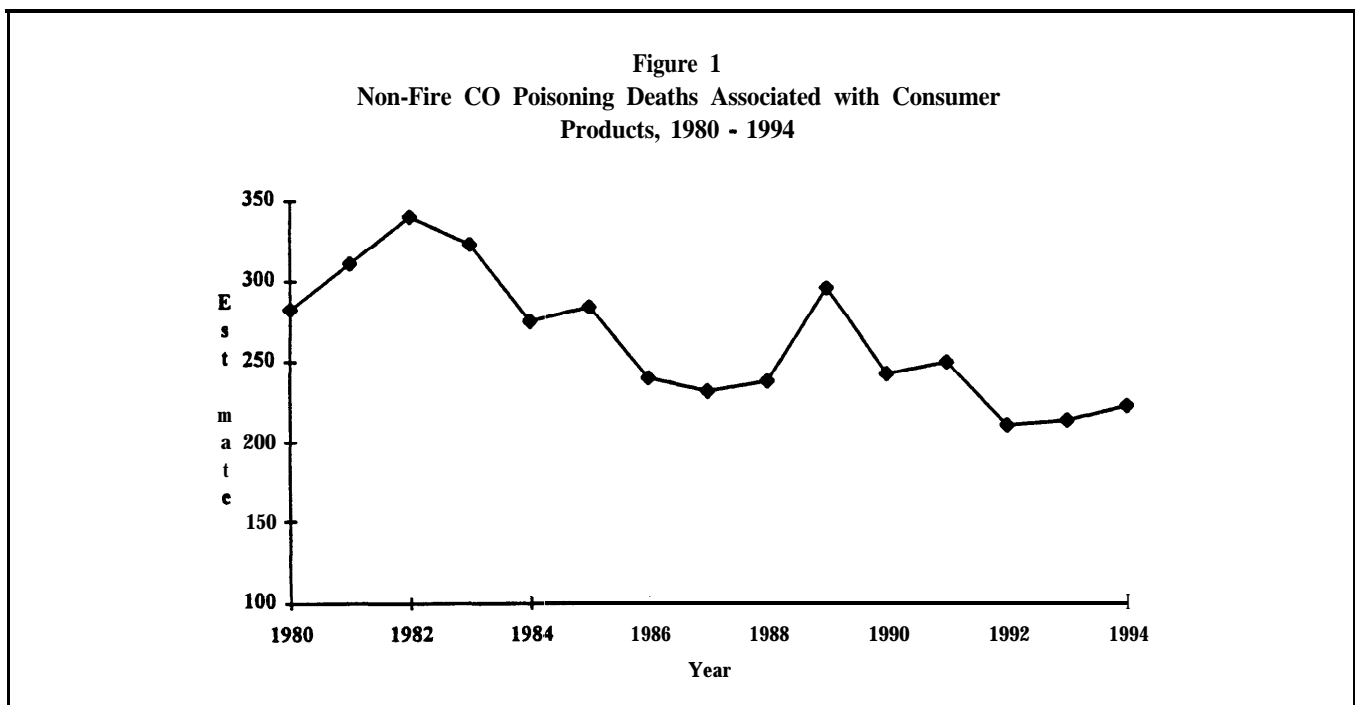
Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Consumer Products, 1980-1994

Year	Estimate
1994	223
1993	214
1992	211
1991	250
1990	243
1989	296
1988	238
1987	232
1986	240
1985	284
1984	275
1983	323
1982	340
1981	311
1980	282

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1980 - 1994.

Note: The p-value for the regression analysis F-test statistic was 0.0011. A significant value is a value less than 0.05 for a 95% confidence test.



Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1980 - 1994.

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